

REMARKS

Claims 7-28 are pending in the present application. Claims 7-17 and 19-28 are rejected and claim 18 is objected to. Claims 11, 13 and 23 are amended hereby.

Claims 11, 13 and 23 were each objected to on the basis of several informalities. Applicants have amended claims 11, 13 and 23 keeping in mind the comments offered by the Examiner, for which courtesy the Examiner is thanked. Applicants submit that claims 11, 13 and 23 are now in allowable form, and respectfully request withdrawal of the objections.

Claims 7-10 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,416,342 (Edmond, et al.) in view of U.S. Patent No. 3,965,279 (Levinstein, et al.). Responsive thereto, Applicants respectfully traverse.

To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Applicants submit that the cited references fail to disclose or suggest all the limitations of the pending claims, and that therefore *prima facie* case of obviousness has not been established in regard thereto.

Edmond, et al., discloses a conventional method of forming alloyed or annealed contacts on a silicon-carbide semiconductor substrate. Edmond, et al.,

teaches that the contact metal must be alloyed or annealed after being deposited on the substrate in order to form an ohmic contact. (*column 5, lines 1-10*).

Levinstein, et al., teaches that ohmic contacts are formed to/on an n-type III-V semiconductor substrate by first forming a layer of germanium over the substrate, then forming a layer of palladium over the germanium. (*column 2, lines 45-60*). The structure is sintered (preferably) from 300-550°C for 10 minutes to 3 hours. (*column 3, lines 23-26*). The resulting contacts have electrical properties similar to those formed by prior art alloying techniques.

In contrast, claim 7 recites in part “forming a first metal-containing layer . . . [consisting] substantially of a metal . . . [contacting] an exposed region that includes silicon carbide . . . [having] a composition that does not form an ohmic contact with a doped silicon carbide if annealed for a time period of less than ten hours”. (*Emphasis Added*). Applicants submit that no combination of the cited references show or suggest such limitations.

The Examiner correctly notes that Edmond, et al., fails to teach or suggest annealing at a temperature less than the melting point of the metal in the metal layer and for a period of time in excess of ten hours. Thus, Edmond, et al., fails to disclose or suggest forming a first metal-containing layer consisting substantially of a metal and in contact with an exposed region that includes silicon carbide, the metal layer having a composition that does not form an ohmic

contact with a doped silicon carbide if annealed for a time period of less than ten hours, as recited in part by claim 7.

The Examiner asserts that Levinstein, et al., teaches that it is well known to form an ohmic contact by heating a metal layer at a temperature less than the melting point of the metal for a period of time in excess of ten hours. However, the contact being formed is a contact to an n-type group III-V semiconductor. Group III-V semiconductors are made of two or more elements, and are referred to as group III-V semiconductors because their first and second elements are found in group III and group V of the periodic table, respectively. Common examples of group III-IV semiconductors include GaAs and InP.

In contrast, the present invention forms an ohmic contact by forming a metal-containing layer that is in contact with an exposed region that includes silicon carbide. Silicon carbide is not a III-V semiconductor material, nor is silicon carbide part of a III-IV semiconductor. The metal layer of Levinstein, et al., is formed over/upon a heavily-doped layer of III-V semiconductor material. (*column 1, line 62 through column 2, line 5*). The metal layer of Levinstein, et al., is not formed on a layer of silicon carbide nor on a layer containing silicon carbide. Thus, Levinstein, et al., fails to disclose or suggest forming a first metal-containing layer consisting substantially of a metal and in contact with an exposed region that includes silicon carbide, as recited in part by claim 7.

Levinstein, et al., also teaches that the optimum heat treatment is 300-550°C for 10 minutes to 3 hours, and that such parameters produce ohmic contacts having electrical properties comparable to contacts formed by the prior art alloying techniques. (*column 3, lines 23-26*). Levinstein, et al., thus teaches that ohmic contacts are formed in less than ten hours. Thus, Levinstein, et al., fails to disclose or suggest that the metal layer have a composition that does not form an ohmic contact with a doped silicon carbide if annealed for a time period of less than ten hours, as recited in part by claim 7.

Since the cited references fail to disclose or suggest all the limitations of claim 7, Applicants submit that a *prima facie* case of obviousness has not been established in regard thereto. Accordingly, Applicants submit that claim 7 and claims 8-18 depending therefrom are in condition for allowance and respectfully request same.

Further responsive to the rejection of claim 7 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,416,342 (Edmond, et al.) in view of U.S. Patent No. 3,965,279 (Levinstein, et al.), Applicants respectfully point out that in order to establish a *prima facie* case of obviousness there must be some suggestion or motivation to combine reference teachings. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). However, where a proposed modification (or combination) would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation

to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). Thus, where a proposed modification renders the prior art invention being modified unsatisfactory for its intended purpose, a *prima facie* case of obviousness has not been established.

Applicants submit that the combination proposed by the Examiner results in a composite device that is not satisfactory for its intended purpose, and that therefore a *prima facie* case of obviousness has not been established.

Edmond, et al., teaches that any metal layer formed over silicon carbide (SiC) must be annealed at relatively high temperatures to form an ohmic contact. Levinstein, et al., teaches that ohmic contacts are formed to/on an n-type III-V semiconductor substrate by first forming a layer of germanium over the substrate, then forming a layer of palladium over the germanium. The composite device resulting from the proposed combination would have a layer of germanium upon an SiC substrate with a layer of palladium over the germanium. That structure, even after sintering per Levinstein, et al., would not form an ohmic contact with the SiC substrate since the SiC substrate is not a III-V semiconductor material. Thus, the composite device lacks an ohmic contact to the substrate and is therefore unsuited for its intended purpose.

Since the composite device would be unsuited for its intended purpose, Applicants submit that a *prima facie* case of obviousness has not been established in regard to claim 7. Accordingly, Applicants submit that claim 7 and

claims 8-18 depending therefrom are in condition for allowance and respectfully request same.

Moreover, a prior art reference that "teaches away" from the claimed invention is a significant factor to be considered in determining obviousness. *In re Gurley*, 27 F.3d 551, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994). It is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983).

Applicants submit that the cited references teach away from the combination proposed by the Examiner and that, therefore, a *prima facie* case of obviousness has not been established.

Levinstein, et al., is specifically limited to a structure for forming an ohmic contact to a III-V semiconductor substrate or a layer of III-V semiconductor material, whereas Edmond, et al., is limited to forming an unalloyed reflective metal layer on a layer of highly-doped silicon carbide. Thus, each of the references teaches away from a combination with the other.

Since each of the references teaches away from being combined with the other, Applicants submit that a *prima facie* case of obviousness has not been established in regard to claim 7. Accordingly, Applicants submit that claim 7 and claims 8-18 depending therefrom are in condition for allowance and respectfully request same.

For the foregoing reasons, Applicants submit that a *prima facie* case of obviousness has not been established in regard to claim 7. Accordingly, Applicants submit that claim 7 and claims 8-18 depending therefrom are in condition for allowance, which is hereby respectfully requested.

Claims 19-20, 22-24 and 26-28 were also rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,416,342 (Edmond, et al.) in view of U.S. Patent No. 3,965,279 (Levinstein, et al.). Responsive thereto, Applicants respectfully traverse.

Claim 19 recites in part "forming a metal-containing layer consisting substantially of a metal . . . that contacts an exposed region, wherein the exposed region includes silicon carbide" and "annealing the metal-containing layer . . . for . . . at least approximately ten hours and at a temperature of at least approximately 300 C". (*Emphasis Added*). Thus, the subject matter recited in part by claim 19 is substantially similar, in that regard, to the subject matter recited in part by claim 7. Thus, for the same reasons given above in connection with claim 7, Applicants submit that a *prima facie* case of obviousness has not been established in regard to claim 19. Accordingly, Applicants submit that claim 19 and claims 20-28 depending therefrom are in condition for allowance, which is hereby respectfully requested.

Claims 11, 15, 21 and 25 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,416,342 (Edmond, et al.) in view of

U.S. Patent No. 3,965,279 (Levinstein, et al.) and further in view of Japanese Patent document No. 59-214224A (Sano). Responsive thereto, Applicants respectfully point out that claims 11 and 15 depend from claim 7, and that claims 21 and 25 depend from claim 19. Claims 7 and 19 are in condition for allowance for the reasons given hereinabove. Accordingly, Applicants submit that claims 11, 15, 21 and 25 are also in condition for allowance and respectfully request same.

Claim 18 was indicated as being allowable if rewritten in independent form to include all the limitations of its base claim and any intervening claims, for which courtesy the Examiner is thanked. Applicants respectfully defer rewriting claim 18 in independent form until the Examiner has had an opportunity to review the remarks herein.

For all the foregoing reasons, Applicants submit that the pending claims are definite and do particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Moreover, Applicants submit that cited references fail to disclose or suggest, alone or in combination, the subject matter of the pending claims. The pending claims are therefore in condition for allowance. Accordingly, Applicants respectfully requests withdrawal of all rejections and objections, and allowance of the claims.

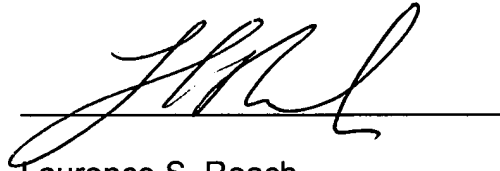
In the event that Applicants have overlooked the need for an extension of time, an additional extension of time, payment of fee, or additional payment of fee, Applicants hereby conditionally petition therefore.

The Examiner is invited to telephone the undersigned in regard to this Amendment and the above identified application.

Respectfully submitted,

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Date


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